9/3/2016

سكشن [3] المهندس/ عمرو

AMR

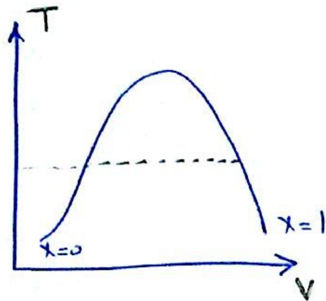
Heat Transfer

Modes of Heat Transfer.

sheet No. 1

No. 13

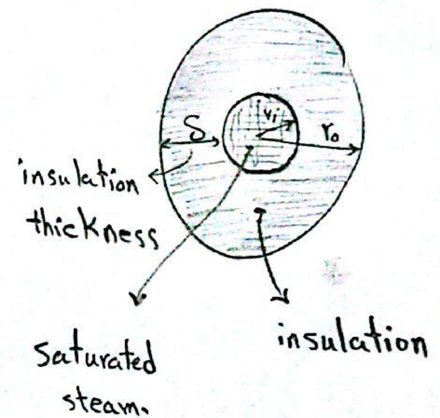
Critical radius of insulation (r_{cr})
For spherical wall.

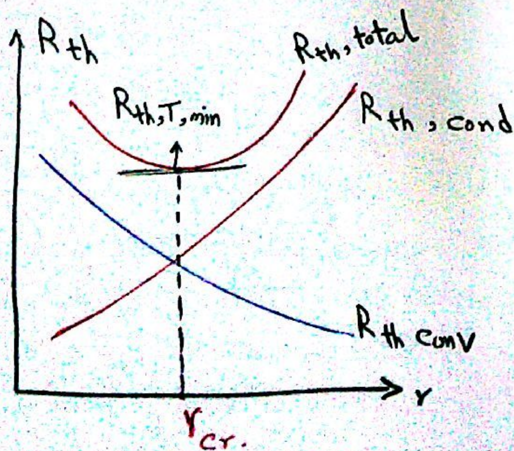


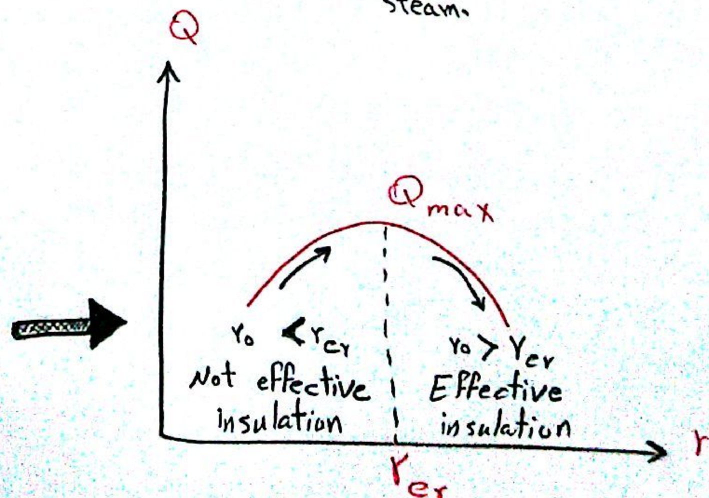
$$R_{th})_{cond})_{\substack{spherical\\wall}} = \frac{r_o - r_i}{4\pi K \; r_i * r_o}$$

$$R_{conv} = \frac{1}{h_o \cdot A} = \frac{1}{h_o * 4\pi \, r_o^2}$$

let we have a sphere
and r_i is Fixed according to the application we have r_o is Variable with adding an insulation.







b

No. 14 $\dot{Q} = \dfrac{\Delta T}{\dfrac{1}{4\pi K}\left[\dfrac{1}{r_o} - \dfrac{1}{r_i}\right]}$

No.13 تذكرة

$$\sum R_{th} = \frac{r_o - r_i}{4\pi K \; r_i * r_o} + \frac{1}{h_o * 4\pi r_o^2}$$

at the (~~maximum~~ minimum) values of curve $\dfrac{d R_{th,T}}{dr} = 0$

$$\frac{1}{4\pi K \, r_i} - \frac{1 \; r_o^{-1}}{4\pi K} + \frac{1}{h_o * 4\pi r_o^2} = 0$$

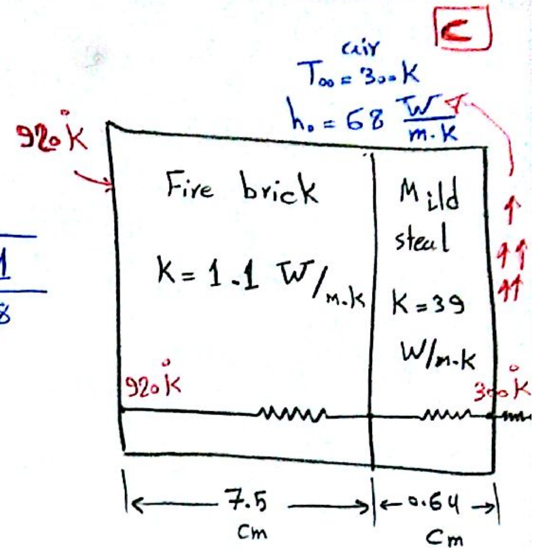
→ 0

$$\frac{1}{4\pi K \, r_o^2} = \frac{2}{h_o * 4\pi r_o^3}$$

$$r_o = r_{cr} = \frac{2K_{ins}}{h_o}$$ → insulation

Problem . [12] Case [2] [C]

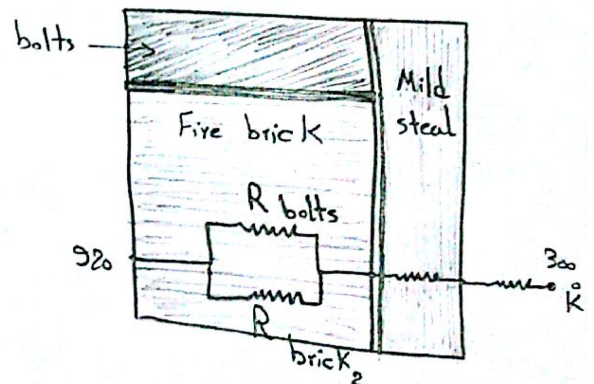
$$q_1^{\circ} = \frac{Q^{\circ}}{A} = \frac{920 - 300}{\frac{0.075}{1.1} + \frac{0.0064}{39} + \frac{1}{68}}$$



If in addition 18 bolts extended through the Furnace wall

$d_{bolt} = 1.9$ cm

solution



Let $K_{bolts} = K_{m.s} = 39 \frac{W}{m.K}$

$$R_{th})_{m.s} = \frac{L_{m.s}}{K_{m.s} * A} = \frac{0.0064}{39 * 1}$$

$$R_{th})_{conv} = \frac{1}{h_o * A} = \frac{1}{68}$$

$$R_{th})_{brick_2} = \frac{L_{f.b}}{K_{f.b} * (A)_{f.b}} = \frac{0.075}{1.1 * (1 - A_{bolts})} =$$

$$A_{bolts} = \frac{\pi}{4}(d_{bolt})^2 * 18 = \frac{\pi}{4}\left(\frac{1.9}{100}\right)^2 * 18 =$$

$$R_{th})_{bolts} = \frac{L_{bolts}}{K_{bolts} \cdot A_{bolts}} = \frac{0.075}{39 * A_{bolts}} =$$

$$R_{eqn}\ (\text{bolts} \,//\, \text{Fire brick}) = \frac{R_{bolts} + R_{f.b}}{R_{bolts} * R_{f.b}}$$

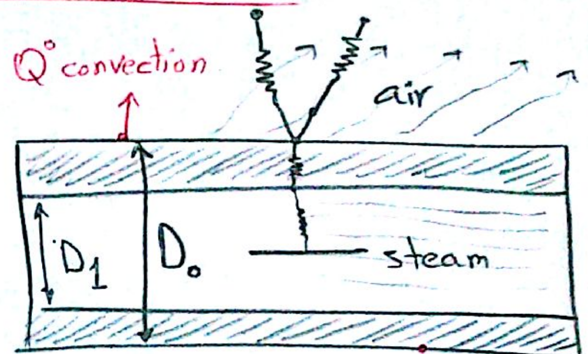
d

$$\sum R_{th} = R_{eqn} + R_{m.s} + R_{conv}$$

$$\dot{q}_2 = \frac{920 - 300}{\sum R_{th\,Total}} = \text{———} \; \frac{W}{m2}$$

* % increase in H.T. $= \frac{\dot{q}_2 - \dot{q}_1}{\dot{q}_1} * 100$ - - - - %

Prob 11



$D_i = 60$ mm

$D_o = 75$ mm

$K_p = 58 \frac{W}{m.K}$

Pipe emissivity $\varepsilon = 0.8$

$T_{surr} = 20$ °C

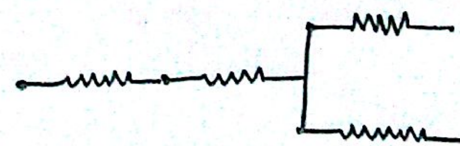
Inside Fluid

(steam) → $T_{in} = 250$°C , $h_{in} = 500 \frac{W}{m^2.K}$.

out side

(air) → $T_\infty = 20$°C , $h_o = 25 \frac{W}{m^2.K}$.

inside



out side

From steady Flow of H.T

$$\dot{Q}_{conv_{in}} = \dot{Q}_{cond_{wall}} = \dot{Q}_{conv_{out}} + \dot{Q}_{rad}$$

e)

$$q' = \frac{\dot{Q}}{L} \qquad q'' = \frac{\dot{Q}}{A}$$

$$\dot{Q}_{conv,in} = \frac{250 - T_{s_{in}}}{\left(\frac{1}{500 * \pi D_i * L}\right)} = \frac{T_{s_{in}} - T_{s_{out}}}{\left(\frac{\ln(r_o/r_i)}{2\pi K L}\right)} = \dot{Q}_{cond,wall}$$

$D_i \rightarrow 60 * 10^{-3}$, $L \rightarrow 1$, $L \rightarrow 1$

$$= \frac{T_{s_o} - 20}{\left(\frac{1}{25 * \pi D_o L}\right)} + \varepsilon \delta A \left(T_{s_o}^4 - T_{surr}^4\right)$$

$\varepsilon \rightarrow 0.8$, $\delta \rightarrow 5.67 * 10^{-8}$, $A \rightarrow \pi D_o L$, $T_{surr} \rightarrow (20 + 273^\circ)\ K$

From steady flow of Heat

$$\dot{Q}_{steam\ (outer\ surface)} = \dot{Q}_{outer\ surface}$$

outer surface → air convection, surr $\dot{Q}$ radiation

$$\frac{250 - T_{s_o}}{\frac{1}{500 * \pi D_i L} + \frac{\ln(r_o/r_i)}{2\pi K_p . L}} = \dot{Q}_{rad} + \dot{Q}_{conv_{out}}$$

حفظ

$\delta = 5.67 * 10^{-8}$

$0 \leqslant \varepsilon \leqslant 1$

0 → Perfect reflector.

1 → black Body.

ويحل المعادلة بطريقة Trial and error

let $T_{s_o} = 50$ —وبالتعويض→ [X]

$T_{s_o} = 100$ —وبالتعويض→ [X]

$T_{s_o} =$ ~~228~~ —وبالتعويض→